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ABSTRACT

This booklet summarizes results of research and literature reviews that had been collected in a source book titled "Physical Activity & Well-Being" and published in 1986 by the National Association for Sport and Physical Education. The evidence presented suggests that exercise can reduce or delay the undesirable effects of many degenerative diseases and concurrently serves as a therapeutic agent in mental and physical illnesses. Separate sections of this booklet describe: (1) the benefits of physical activity; (2) motor skill acquisition; (3) physical growth and biological maturation; (4) skilled performance and health-related fitness; (5) neuromuscular function and academic achievement; (6) mental, social, and moral development; and (7) special conditions, aging, and activity. A position paper is also presented dealing with the contributions of physical activities to well-being. A glossary of terms is included. (CB)

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The Value *of* Physical Activity

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The Value of Physical Activity

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Foreword

The summary and interpretation found on subsequent pages are based on the content of the book *Physical Activity & Well-being*. The source book from which this content was extracted represents the most recent and comprehensive review of the literature currently available concerning physical activity and its relationship to total health.

This publication was written for those who seek the practical implications that are suggested by the reviews in *Physical Activity & Well-being*. In addition, those who do not have a background in the psychology, sociology, and physiology of human movement will find that this abbreviated version provides a comprehensive overview of the outcomes that can be expected when physical activity programs are properly implemented. Public school administrators, curriculum specialists, school board members, legislators, and parents who read this interpretation of the research literature will learn of many compelling reasons for the inclusion of sound physical education programs in the K-12 curriculum.

Although the statements in this publication cannot do justice to the wealth of information found in the eighteen chapters of *Physical Activity & Well-being*, they serve as an overview of the benefits available through physical activity. Persons who do not have the time or the background to read the source book will receive a concise account of the numerous ways that regular exercise contributes to good health. For others, the statements provided here may stimulate a desire to learn more about the context in which the benefits of physical activity are most likely to occur.

The primary contribution of this book lies in its compelling documentation of the association between physical activity and good mental and physical health. The overwhelming evidence indicates that exercise can reduce or delay the undesirable effects of many degenerative diseases, and concurrently serves as a therapeutic agent in mental and physical illnesses. Its value as a regular ingredient in daily living from infancy through old age has been confirmed time and again by the research. In addition to its many preventative and rehabilitative benefits, activity in some form adds quality to the lives of millions who use it for recreational and aesthetic purposes.

The accumulation of evidence pertaining to the healthful effects of regular exercise is of little value unless it is put into practice. This could be accomplished most effectively if parents, school administrators, physicians, and employers were to unite in a common cause to promote the health-related benefits of physical activity. Three interrelated purposes must be promoted. They are to: (1) place a higher value on the incorporation of vigorous physical activities into daily schedules; (2) promote the implementation of scientifically-based activity programs

in the home, school and the work site; and (3) demand that the activity programs currently in place produce evidence of their effectiveness in terms of feasible results.

This compilation of the benefits that can be derived from physical activity should result in a more determined effort to provide information and services to a receptive audience. Clearly, the maximum contribution of physical activity is only possible when it is initiated early in life and continued throughout the life span. Activity must be promoted in both the home and the school in order to realize its full range of benefits. The challenge now is to ensure that those who have the potential for deriving the greatest values from exercise also have the opportunities to do so.

Vern Seefeldt
Paul Vogel

Preface

This document interprets the reviews of literature contained in the source book *Physical Activity & Well-being*. It begins with a series of statements proclaiming the benefits of physical activity. These statements are supported in the subsequent six sections with evidence that has been excerpted directly from the 18 chapters of the source book. The concluding section is written as a "white paper" to provide a concise compilation of scientific literature relating physical activity to biological and behavioral health.

Each statement in this document provides a partial answer to the question, "What is the contribution of physical activity to total well-being?" Persons who, for a variety of reasons, are unable to read the sourcebook, but are able to digest this synopsis, will find in it 161 statements attesting to the benefits of physical activity. Whenever feasible, direct implications to programmatic settings and qualifications of instructors are also provided.

This summary of the information contained in *Physical Activity & Well-being* is written for several purposes. Those who seek evidence for the promotion of physical activity in personal or public programs will find ample evidence for its inclusion. Those who have been challenged to justify the existence of current activity programs will learn of the many potential contributions and the context in which the benefits of physical activity are likely to occur. Those who read this compendium simply because of intellectual curiosity are likely to be impressed with the many parameters of human function that can be positively influenced by exercise.

This accumulation of facts about physical activity comes at a time when a nation of potential beneficiaries seems beseechingly receptive to evidence concerning its benefits. The prudent incorporation of physical activity in the living patterns of individuals young and old has tremendous implications for our nation's health care, vocational productivity, socioeconomic climate, and general quality of life. The authors hope that this condensation of evidence pertaining to the value of physical activity provides additional impetus for its inclusion as an essential ingredient in daily living.

Purposes of the American Alliance For Health, Physical Education, Recreation and Dance

The American Alliance is an educational organization, structured for the purposes of supporting, encouraging, and providing assistance to member groups and their personnel throughout the nation as they seek to initiate, develop, and conduct programs in health, leisure, and movement-related activities for the enrichment of human life.

Alliance objectives include:

1. Professional growth and development—to support, encourage, and provide guidance in the development and conduct of programs in health, leisure, and movement-related activities which are based on the needs, interests, and inherent capacities of the individual in today's society.
2. Communication—to facilitate public and professional understanding and appreciation of the importance and value of health, leisure, and movement-related activities as they contribute toward human well-being.
3. Research—to encourage and facilitate research which will enrich the depth and scope of health, leisure, and movement-related activities; and to disseminate the findings to the profession and other interested and concerned publics.
4. Standards and guidelines—to further the continuous development and evaluation of standards within the profession for personnel and programs in health, leisure, and movement-related activities.
5. Public affairs—to coordinate and administer a planned program of professional, public, and governmental relations that will improve education in areas of health, leisure, and movement-related activities.
6. To conduct such other activities as shall be approved by the Board of Governors and the Alliance Assembly, provided that the Alliance shall not engage in any activity which would be inconsistent with the status of an educational and charitable organization as defined in Section 501(c) (3) of the Internal Revenue Code of 1954 or any successor provision thereto, and none of the said purposes shall at any time be deemed or construed to be purposes other than the public benefit purposes and objectives consistent with such educational and charitable status.

Bylaws, Article III

Acknowledgement

The statements in this document were extracted from their original sources by the Committee on Interpretations of the *National Association For Sport and Physical Education*. Members of the Committee include: Kate Barrett, University of North Carolina, Greensboro; Candace Norton, Georgia Department of Education, Atlanta; Wayne Osness, University of Kansas, Lawrence; Betty Reid, Maryland Department of Education, Baltimore; Vern Seefeldt, Michigan State University, East Lansing (Chair); and Paul Vogel, Michigan State University, East Lansing.

(The contents of *The Value of Physical Activity* were extracted from the source book *Physical Activity & Well-being*. The chapter titles and their authors are presented below.)

Physical Activity & Well-being[1]

Vern Seefeldt, Editor

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2 Acquisition of Motor Skills During Childhood
John L. Haubenstricker and Vern D. Seefeldt, Michigan State University, East Lansing

3 Development of Sensory-Motor Function in Young Children
Harriet G. Williams, University of South Carolina, Columbia

4 Memory Development and Motor Skill Acquisition
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Jere Dee Gallagher, University of Pittsburgh

5 Physical Activity and the Prevention of Premature Aging
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6 Physical Activity and Body Composition
Pat Eisenman, University of Utah, Salt Lake City

7 Neuromuscular Adaptations to High-Resistance Exercise
Gary Kamen, Indiana University, Bloomington

[1] *Physical Activity & Well-being* was published in 1986 by the *National Association For Sport and Physical Education*, an association of the *American Alliance for Health, Physical Education, Recreation, and Dance*, Reston, Virginia.

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CHAPTER ONE

Benefits of Physical Activity

The statements which follow are presented as *outcomes* that can be obtained through the prudent and timely participation in physical activity. Each of the statements represents a summary of the scientific evidence that was provided by the authors of *Physical Activity & Well-being*. Each of the outcomes is supported by a series of statements, presented in the six subsequent sections of this document.

The outcomes presented here were selected because of their relevance to programs of physical education. The list does not include all of the potential outcomes to be attained through exercise, nor does omission lessen their importance as objectives to be achieved through physical activity. The inclusion of outcomes in this list signifies that they can be readily achieved through participation in the appropriate kinds and amounts of physical activity. Readers who seek information about additional outcomes are urged to consult the source book, which contains an extensive bibliography of the original citations.

Participation in the Appropriate Kinds and Amounts of Activity

1. Promotes changes in brain structure and function in infants and young children. Sensory stimulation through physical activity is essential for the optimal growth and development of the young nervous system.
2. Promotes early cognitive function through imitation, symbolic play, the development of language, and the use of symbols.
3. Assists in the development and refinement of perceptual abilities involving vision, balance, and tactile sensations.
4. Enhances the function of the central nervous system through the promotion of a healthier neuronal network.
5. Aids the development of cognition through opportunities to develop learning strategies, decision making, acquiring, retrieving, and integrating information and solving problems.
6. Fortifies the mineralization of the skeleton and promotes the

maintenance of lean body tissue, while simultaneously reducing the deposition of fat.

7. Leads to proficiency in the neuromuscular skills that are the basis for successful participation in games, dances, sports, and leisure activities.
8. Is an important regulator of obesity because it increases energy expenditure, suppresses appetite, increases metabolic rate, and increases lean body mass.
9. Improves aerobic fitness, muscle endurance, muscle power, and muscle strength.
10. Is an effective deterrent to coronary heart disease due to its effects on blood lipids, blood pressure, obesity, and capacity for physical work.
11. Improves cardiac function as indicated by an increased stroke volume, cardiac output, blood volume, and total hemoglobin.
12. Is associated with a reduction in atherosclerotic diseases.
13. Promotes a more positive attitude toward physical activity and leads to a more active lifestyle during unscheduled leisure time.
14. Enhances self-concept and self-esteem as indicated by increased confidence, assertiveness, emotional stability, independence, and self-control.
15. Is a major force in the socializing of individuals during late childhood and adolescence.
16. Is instrumental in the development and growth of moral reasoning, problem solving, creativity, and social competence.
17. Is an effective deterrent to mental illness and the alleviation of mental stress.
18. Improves the psychosocial and physiological functions of mentally and physically handicapped individuals.
19. Deters the depletion of bone mineral and lean body tissue in elderly individuals.
20. Prevents the onset of some diseases and postpones the debilitating effects of old age.

An elaboration of these benefits is found in the 161 statements contained in the following six sections of this document.

CHAPTER TWO

Motor Skill Acquisition

The acquisition and refinement of movement skills, whether involving the total body in activities such as running and jumping or in fine motor tasks such as tying one's shoe laces, is regarded as an essential part of normal growth, development, health maintenance and aging. However, the degree to which these skills are acquired and maintained as a result of normal processes, as opposed to the contributions made by organized activity programs, has been a matter of controversy. Evidence from research conducted during the last two decades has clarified the role of movement: (1) in normal cognitive, moral and social development; (2) as an agent in normal physical growth and biological maturity; and (3) as a precursor to the life-long patterns inherent in the games, dances and sports of our culture. The following statements recount the role of movement in these functions.

1. There is a well-determined order and sequence of reflexes, reactions and fundamental motor skills which are common to children regardless of gender, race or culture. These reflexes, reactions and skills are called "fundamental" because they serve as the foundation for future motor skill development. (Haubenstricker and Seefeldt; Williams)

2. Early environments, whether intrauterine, neonatal or those of infancy and early childhood, have a profound effect on the child's subsequent cognitive and perceptual-motor development. (Haubenstricker and Seefeldt; Thomas and Gallagher; Williams)

3. Voluntary movement patterns of infancy are closely associated with the substrate of reflexes and patterned reactions. Perfection of voluntary movements requires the interaction of growth, maturation, and opportunities to integrate emerging skills with previous ones. (Haubenstricker and Seefeldt)

4. The order in which specific motor behaviors emerge is common to nearly all infants. With increasing age, the variability in appearance of voluntary motor behavior increases. This reflects the greater opportunities of environment, in lieu of genetics, to influence the nature and rate of skill acquisition. (Haubenstricker and Seefeldt)

5. The ease of changing of motor behavior in early life, combined with the motivation to move while learning, suggests that childhood is an ideal time to acquire new motor skills and refine those that are already present. (Haubenstricker and Seefeldt; Thomas and Gallagher; Williams)

6. Integration of the sensory-motor system, as observed in refined motor functions, requires proper encouragement, abundant opportunities for practice and the selection of activities that are appropriate to a child's level of readiness. Teachers of movement must be familiar with the strategies that children are capable of using at various ages, and the relationship of previous to present experiences if they are to provide proper learning environments. (Thomas and Gallagher; Williams)

7. Two essential benefits of early sensory-motor experiences are increased abilities to suppress inappropriate responses (for example, involving the total body, when movement of one hand is sufficient) and the selective attention to useful cues, while simultaneously ignoring irrelevant information. These opportunities for movement and concommitant skill acquisition during infancy and early childhood provide the foundation that is essential to skilled performance at later ages. (Thomas and Gallagher; Williams)

8. Development sequences of the key elements constituting numerous skills of locomotion and object control have been identified. These sequences should become the basis of error detection, error correction, and the selection of appropriate motor learning experiences for children. (Haubenstricker and Seefeldt)

9. Although there is a linear progression in the proficiency of fundamental motor skills during childhood, there is a great within-age variability that frequently spans the mean performance of adjoining ages. For this reason, teachers must be prepared to deal with a wide range of abilities and general inconsistencies in performance during the elementary school years. (Haubenstricker and Seefeldt)

10. There is considerable overlap in the motor performance of boys and girls of the same chronological age during early and middle childhood. However, gender differences favoring boys in skills that require strength, power, and agility and girls in skills that require balance and flexibility are already present at these ages. (Haubenstricker and Seefeldt)

11. Comparisons of motor performance in jumping, throwing, kicking, and striking, whether quantitative or qualitative, favor boys over girls through childhood. These differences are increased

during late childhood and the teenage years. (Haubenstricker and Seefeldt)

12. Successful participation in the dances, games, and sports of our culture depends upon proficiency in numerous fundamental movement skills. Children who have competencies in the fundamental skills are at an advantage when new skills are introduced because the new skills are likely to contain components of those already learned. (Haubenstricker and Seefeldt)

13. Children who are proficient in motor tasks during childhood are more relaxed and adept at learning subsequent skills. (Haubenstricker and Seefeldt)

14. Teaching movement skills from a knowledge of their sequential development has much to recommend it: the sequences are readily learned by teachers; they can be accurately assessed; they provide the information necessary for instruction; and they lend themselves to verification. The fact that many teachers of movement are not competent in the use of sequences should not detract from their application. (Haubenstricker and Seefeldt)

15. Cognition, or knowing how to perform a motor task, is an integral part of learning to move. Learning motor skills involves planning the correct movement, performing it, gathering information about its outcome, and making the necessary changes for the next attempt. This process requires many repetitions and significant feedback if skillful performance is to result from it. (Thomas and Gallagher)

16. Early attempts at learning a skill are highly dependent upon vision. With practice, the learner relies less on vision as control shifts from dependency on external to internal cues. The result is the movements become more rapid, smooth, and coordinated. (Thomas and Gallagher)

17. Skillful individuals are able to perform under a variety of circumstances and are able to detect how the outcome of a skill relates to the duration, force, pattern, and size of the movement. This adaptation suggests that the practice of skills should take place under varying conditions. (Thomas and Gallagher)

18. The ability to benefit from a demonstration depends on the age and cognitive abilities of the learner. The ability to intentionally remember a movement is not well developed until approximately six or seven years of age. The ability to use vision in motor performance is also greatly improved after age seven. Teachers of movement must consider these principles when selecting the tasks to be learned. (Thomas and Gallagher)

19. The motor performance of children is improved by such teach-

er-assisted strategies as applying labels to portions of a movement, attending to meaningful cues, actively rehearsing the movement, receiving knowledge of results and attempting to remember the sequence or order of a complex skill. A competent teacher will ensure that this information and the appropriate strategies are part of the learning process. (Thomas and Gallagher)

20. Children are not as skillful as older individuals for a variety of reasons, including cognitive limitations. Among these are a storage center that contains little information, inadequate arrangement of that information and the inability to retrieve the information for immediate use. However, they are able to acquire a rich knowledge base in a specific area and become very proficient in it. (Thomas and Gallagher)

21. Children must learn to integrate information from the major sensory systems, such as the auditory, visual, tactile, and kinesthetic, if they are to acquire the more refined motor functions necessary to regulate posture and perform a variety of movement tasks. (Williams)

22. Requiring children to make rapid decisions while performing a skill causes a deterioration in performance because of children's inability to select the correct responses when called upon to do so quickly. (Thomas and Gallagher)

23. One consistent correlate of sub-standard motor performance and low levels of aerobic fitness levels in children is excessive body fat. Excessive weight in early childhood is not only associated with coronary heart disease, but it also impedes motor development. This cyclic process of weight gain and delayed motor development must be interrupted through proper activity levels and diet. (Eisenman)

24. There is some evidence that the joy of movement and the healthful benefits of vigorous activity have their genesis in the experiences of childhood. Skills and sports that are used in adulthood generally were learned during childhood. (Haubenstricker and Seefeldt)

CHAPTER THREE

Physical Growth and Maturation

Physical growth and maturation are biological processes that dominate the first two decades of life. We do not actually measure the processes involved in these phenomena, but their outcomes are observed and assessed. Much attention is directed to the assessment of growth during infancy and childhood because its progress is an index of the beneficial or detrimental environmental variables by which it is influenced. Thus, nutrition, rest, psychological status, physical activity and many other factors determine how a child grows, within the bounds set by genetics. The age-old questions of "How much activity is necessary for maximum stimulation of growth?" and "When does the stimulation become excessive?" are impossible to answer fully, given the evidence available at this time, but a partial response is provided by the following statements.

Biological maturity is of great concern to parents and educators because of its relationship to the body's readiness to perform certain functions, tolerate certain stresses, and profit from certain kinds of intellectual stimulation. Pertinent to this review is the influence of physical activity in either advancing or retarding the rate of biological maturation. Although, once again, there are no unequivocal answers, research conducted on young athletes who have been subjected to rigorous training programs has provided us with some answers to the influence of activity on biological maturity.

25. Physical activity, as assessed in the work, play, and training programs of children and youth, apparently has no detectable effect on their *stature* or *maturation*, as measured by skeletal age or sexual maturation. Even the strenuous training programs to which many young athletes are subjected do not seem to adversely affect their stature or rate of maturation. (Malina)

26. Physical activity is an important factor in the regulation and maintenance of body weight. Regular physical activity results in an increase of lean tissue and a corresponding decrease in body fat, often without any appreciable change in total body weight. However, the most dramatic changes due to training in children

are associated with fat tissue. Persons of all ages who engage in regular physical activity have less body fat than their sedentary peers. (Eisenman; Malina)

27. Regular physical activity has a significant influence on the growth and integrity of bone and muscle tissue. Activity increases skeletal mineralization and, thereby, the density of bones. Activity also increases the width of bones, resulting in a sturdier skeleton. (Eisenman; Malina)

28. Specifc kinds of activity can cause muscle hypertrophy, resulting in increased contractile proteins and enhanced oxidative enzyme activity. These changes are a function of the *intensity* and *duration* of the activity programs. Even within standardized training programs, the results may be highly individualized; therefore, supervisors of activity programs must correlate the effects of activity with the needs and capabilities of their clients. (Malina)

29. Gender differences in body size and most indicators of physical size and body composition are minor prior to the circumpuberal growth spurt. Boys, in general, tend to be larger in most dimensions, more mesomorphic and have more muscle and lean body mass than girls. Girls tend to be endomorphic and have greater amounts of body fat than boys (Malina). Differences in body size and composition between boys and girls at the extreme ends of the distribution probably account for the superiority of boys in skills that require strength and power, and for girls in skills requiring flexibility and balance. (Haubenstricer and Seefeldt)

30. Gender-related effects of growth and maturity are well defined, with girls attaining their growth spurt, on the average, two years earlier than boys. In boys, the growth spurt is accompanied by a substantial increase in shoulder width and muscle tissue, while fat tissue generally decreases. In girls, puberty is accompanied by a relative increase in hip width and fat tisue, while the total body weight is made up of relatively less muscle tissue. These changes further accentuate the differences in motor performance between males and females that become evident in later childhood. (Haubenstricker and Seefeldt; Malina)

CHAPTER FOUR

Skilled Performance and Health-Related Fitness

There is convincing evidence that physical activity programs, of the proper intensity, duration, and emphasis, can enhance skill levels and the health-related benefits associated with aerobic and anaerobic energy systems. Whether these outcomes are being achieved in school-based physical education programs depends on local circumstances.

This section presents evidence that under the proper conditions, substantive gains in cardio-respiratory, muscular, and neuro-motor functions occur as a result of training and practice. In local programs where these outcomes are not being realized, the challenge is to redirect emphasis and resources into avenues that have a high probability of producing the desired outcomes.

The achievement of objectives related to performance and health-related fitness is esssential to the existence of physical activity programs in the public school curricula. Failure to achieve such objectives represents a dilemma of grave proportions. The assurance presented in this section concerning the attainability of objectives relating to performance and health-related fitness should be encouraging to teachers and supervisors who have attempted to produce outcomes that match expectations. Reviews from which the statements were excerpted provide a compelling case for regular physical activity as an essential component in the lives of children and adults. Failure to achieve these desired outcomes in local programs suggests that their present attempts at attainment require additional scrutiny.

31. Regular physical activity is recommended as an effective treatment for obesity because it increases energy expenditure, may suppress the appetite, increases basal metabolic rate, stimulates fat loss, and minimizes the loss of lean body mass. In addition, physical activity is relatively inexpensive or free, non-toxic, and generally harmless. It may be habit-forming, but seldom addictive. (Eisenman; Haymes)

32. Obesity is a serious health problem because of its association with reduced longevity, non-insulin dependent diabetes, hyper-

lipidemia, hypertension, renal problems, degenerative joint diseases, and complications during pregnancy. Obesity has direct implications for school-based programs because statistics reveal 12% of prepubertal children and 16% of adolescents are obese. Because children spend a large proportion of their day in school-related activities, the school setting appears to be an ideal place to teach lifestyle habits that include proper nutrition and generous amounts of physical activity. (Eisenman)

33. Increased bone mass, as a result of vigorous activity during childhood and adolescence, can provide a reservoir to guard against age-related depletion and osteoporosis, particularly in middle-aged and older women. (Eisenman; Haymes)

34. The body's muscle mass is an important determiner of daily caloric expenditure. Because exercise increases and maintains muscle mass, a continuous program of activity throughout adolescence, adulthood, and old age can retard the loss of lean body tissue and, thereby, curtail the onset of adult-related obesity. (Eisenman)

35. The most efficient way to combat the effects of obesity is to prevent it. The causes of obesity have been clearly defined. The most feasible way to prevent the onset of childhood obesity is to promote exercise and nutrition in school-based programs that involve the entire family. (Eisenman; Haymes)

36. Cardiorespiratory endurance usually can be improved in previously inactive individuals through training programs that require at least 20 minutes of aerobic activity, three or more times per week, at an intensity that is at least 50% of maximal aerobic power. (Eisenman; Pate and Durstine; Wells)

37. Skeletal muscle tissue adapts to endurance training by increasing oxidative capacity. Increased oxidative capacity is the result of increased activity of the enzymes of aerobic metabolism, increased number of mitochondria, increased storage of glycogen and triglycerides, increased utilization of fat as an energy-providing substrate, and increased capillary density. (Pate and Durstine; Spirduso)

38. The stroke volume of the heart is increased in response to endurance training. This increase in stroke volume is associated with decreased heart rate during rest and submaximal exercise, and with increased maximal cardiac output. Total blood volume, plasma volume, red cell mass and total hemoglobin all increase with endurance training. (Pate and Durstine; Spirduso; Wells)

39. Endurance training results in increased power output at maximal exertion. This increase is due primarily to increased maximal

aerobic power which is, in turn, secondary to an increase in maximal cardiac output and maximal arteriovenous oxygen difference. (Pate and Durstine)

40. Tolerance for sustained, submaximal exercise is improved with training. This improvement results from increases in anaerobic threshold and, in some cases, increased work efficiency. (Pate and Durstine)

41. Endurance training tends to reduce premature development of the atherosclerotic diseases such as coronary heart disease. This effect may be due to an improved blood lipid profile, decreased blood pressure in persons with borderline hypertension, decreased percentage of body fat, and decreased myocardial oxygen demand. (Eisenman; Freedson; Pate and Durstine; Wells)

42. Cardiorespiratory endurance tends to decrease with aging in adults. However, endurance training can improve functional capacity and associated cardiorespiratory variables in the elderly. (Pate and Durstine; Spirduso)

43. Due to their greater body fatness, lower blood hemoglobin concentration, and a smaller heart, females, as a group, manifest lower cardiorespiratory endurance than males. However, training causes a percentage increase in maximal aerobic power in females that is comparable to that seen in males. (Pate and Durstine; Wells)

44. Children have a lower tolerance for endurance exercise than young adults. This difference is due to the child's lower absolute maximal aerobic power and lower efficiency in activities like walking and running. Children are physiologically responsive to endurance training if the program is sufficiently demanding and prolonged. (Pate and Durstine)

45. Isometric exercise can be used to increase muscular strength, providing the program includes a minimum frequency of three times per week, an intensity of at least 30% of maximum, a duration of at least six seconds for each contraction, and contractions at several points within the range of motion for each muscle group included. (Kamen)

46. Isotonic exercise may be used to improve strength, providing the exercise occurs at least three times per week, with a load of three to eight repetitions maximum in sets of 3 to 10 exercise bouts. The training effect will occur in 6 to 10 weeks. (Kamen)

47. Strength training programs that exercise muscle groups by lengthening the muscle group provide similar gains to those that involve shortening the muscle group. The lengthening procedure has a tendency to produce more muscle soreness. The best

type of strength training procedure is one that comes closest to the type of contraction experienced in the event for which the athlete is training. (Kamen)

48. Isokinetic exercise involves a maximal force applied through a complete range of motion at a set speed. Strength gains using this procedure are similar to the others; however, this technique provides for the opportunity of speed-specific strength development. (Kamen)

49. Appropriate strength training programs will increase the energy substrates in muscle tissue necessary for high resistance performance, as well as the anaerobic enzymes needed for short-duration activities. (Kamen)

50. Most researchers agree that training does not increase the number of muscle fibers, but increases the size of the fibers to increase overall strength. There is some evidence, however, that fiber splitting may occur, resulting in an increase in the number of fibers or at least an increase in the number of branches of fibers available for contraction. (Kamen)

51. Initial changes in muscular strength appear to be a function of changes in neurological factors which result in improved performance. Later in the training program, the changes appear to be greater in the structure of the cells (fibers) and in the metabolic process that supplies energy to the muscle fibers. (Kamen)

52. The body tends to maintain symmetry; training the musculature of one side transfers to the other side to some degree. This transfer of training is a result of neurological factors involved with the stimulation of the fibers. External electrical stimulation can also increase muscular strength; however, the strength gains are more observable in movements of low velocity. Electrical stimulation has been used most effectively for rehabilitation purposes. (Kamen)

53. Considerable misinformation exists concerning the effects of exercise on menstrual function, as well as the effects of menstrual function on exercise performance. Recent scientific literature regarding this relationship should aid in replacing the numerous myths about this topic with research-based data. Scientific investigations have not detected differences in performance related to phases of the menstrual cycle. (Wells)

54. Researchers studying the effects of the menstrual cycle on physical performance have concluded that: (a) differences in performance were not related to the menstrual phase; (b) oxygen uptake, carbon dioxide production, respiratory rate, and metabolic factors were not affected by the menstrual phase; and (c) hormonal fluctuations during the menstrual cycle did not adversely

affect the exercise performance of trained athletes or of untrained women, even when the latter exercised in a hot-dry environment. (Wells)

55. Highly trained women athletes have a higher incidence of menstrual irregularity or cessation than do nonathletic, nonpregnant, and non-lactating females. Several hypotheses have been proposed to explain this occurrence, but, to date, none have been sufficiently tested to gain widespread support. Exercise-related menstrual cessation is a benign and reversible condition in most athletes. (Wells)

56. A strenuous lifestyle such as that characteristic of a young athlete (8 to 14 years of age) is associated with a later age at menarche, the first menstrual flow. This relationship is particularly evident in gymnasts, ballerinas, figure skaters, divers, and runners. Why young athletes tend to have a delayed menarche is not entirely understood at present. One hypothesis is that young girls who are genetically programmed to be later maturers are also more likely to be athletes because the biological characteristics associated with later maturation (longer legs, narrower hips, etc.) are advantageous in most sports and in dance. (Malina; Wells)

57. While most research supports the belief that sports participation has a generally favorable effect on dysmenorrhea (painful menstruation), a few studies indicate that certain sports, such as swimming, may cause the condition. Updated information on dysmenorrhea in young athletes is needed to reevaluate this question. (Wells)

58. Dehydration is the primary cause of heat illness. Adequate water intake during exercise is necessary for maintaining blood volume and body temperature. If electolyte-laden drinks are used, they should be diluted to ensure rapid emptying from the stomach. (Haymes)

59. There is little evidence that vitamin supplements improve performance when the diet is adequate. Protein needs of athletes also are met by an adequate diet, although the protein requirements for adolescents are greater than for adults, relative to body weight. (Haymes)

60. Low calcium intakes are frequently observed among females. High calcium intake delays bone mineral loss, which occurs in both men and women, but proceeds at a faster rate in women after age 40. (Haymes)

61. Inadequate iron intake is the most common nutritional deficiency in the United States and is especially common among females. Depletion of iron stores in the body leads to iron deficiency anemia and reduced oxygen transport to the tissues. (Haymes)

62. Muscle glycogen stores limit the amount of heavy exercise that can be accomplished. Children have smaller glycogen stores than adults and produce less lactic acid. This may be one of the limiting factors that sets the performance of children apart from that of adults. (Haymes)

63. Fat is a major source of energy at low exercise intensities. Endurance training increases fat mobilization and utilization. (Haymes)

64. Ingestion of diets high in saturated fat is associated with elevated serum cholesterol levels. (Haymes)

65. There is evidence that participation in physical education programs can stimulate desirable shifts in students' physical activity levels and that participation in physical education programs can significantly influence how children feel about physical activity and health-related fitness. There is convincing evidence that participation in physical education programs can improve knowledge relative to healthy lifestyles. (Vogel)

66. There is convincing evidence that participation in physical eduation programs can improve motor performance at all age and grade levels. (Vogel)

67. There is evidence that participation in physical education programs can improve static balance and flexibility at the hip and spine. However, flexibility at the ankle may be decreased. (Vogel)

68. There is convincing evidence that participation in physical education programs can improve aerobic fitness, muscular endurance, muscular power, and muscular strength. (Vogel)

69. There is evidence that participation in physical education programs can positively alter shifts in body composition. However, there is little or no evidence that participation in physical education programs has altered nutritional practices. Therefore, the reduction in body fat and increase in lean body tissue is attributable to the effects of exercise. Alteration of nutritional practices through school-based programs may require a greater concentration of effort than has been evident to date. (Vogel)

CHAPTER FIVE

Neuromuscular Function and Academic Achievement

The study of sensory motor function experienced a revival during the 1960's because of its alleged association with cognitive development, especially in young children and those with sensory or motor impairments. Although the association between neuromuscular function and cognitive development in children had been accepted for some time, it is Piaget, whose theories on cognitive development stimulated research in this area, who deserves credit for renewing the interest of scientists in this controversial topic.

This section clarifies the developmental periods when a cause-and-effect relationship is most likely to exist between neuromuscular function and the growth of intelligence. It also identifies the environments in which activity is likely to assume an adjunctive role in maintenance of nervous system integrity and enumerates the problems inherent in the age-old attempts to establish a cause-effect relationship between participation in activity and academic achievement.

Although an analysis of program results refutes the direct relationship between perceptual motor activities and improvement in intelligence or academic achievement, these programs have generally involved children of school age and frequently those with some identified motor or perceptual deficit. The influence of activity on developing and aging nervous systems appears to be direct and essential. However, research has not clearly established the extent of the dependence, nor the kinds and amounts of activity that are most beneficial to growth and maintenance of the nervous system.

Reviews of existing literature support the following statements:

70. Motor skill development, in both children and adults, involves learning to progressively inhibit unnecessary activity in muscle groups located in widespread parts of the body and to control activity in muscle groups that are essential to the performance of a specific task. (Williams)

71. Play and physical activity provide young children with the opportunities to select sensory information that is relevant to the task they wish to perform and also to learn how to use that information

to produce appropriate responses while suppressing inappropriate ones. (Williams)

72. Children exhibit adult-like responses to specific motor tasks at the time the cerebral cortex is nearing maturation. Thus, the pattern of movement responses in children is determined by experience, within the bounds set by the current maturation of the nervous system. (Williams)

73. Postural control in infants and young children is dominated by the visual system. This linkage between the motor and visual systems is present prior to the time when experience or practice could exert a major influcence. (Williams) The shift from visual dependence to automated responses coincides with the improvement of motor responses in children. (Thomas and Gallagher)

74. An important function of early motor experiences in the infant and child is to learn how to use the various forms of visual, vestibular, and proprioceptive information to regulate movements. (Williams)

75. Movement and cognitive function are only related to the degree that the movement involves substantial cognition, or that success in the movement task underlies successful cognitive performance. The hypothesis that "improving perceptual-motor function will improve cognitive function" comes from the observation that the two areas are positively correlated. (Thomas and Thomas)

76. In children with neurological problems, there is a persistence of the primitive reflexes and a delay in the postural reflexes. Normal motor development is also delayed. However, intervention with augmented sensory feedback has been successful in remediating some of the motor difficulties. (Williams)

77. The ability to perform complex movements skillfully is partially dependent upon the integration of visual and proprioceptive information. Because children under seven years of age do not use visual information well, it is the responsibility of teachers to select activities that will permit the integration of various sensory information without unduly challenging the child's capacities. (Williams)

78. To function effectively in the cognitive mode, the young child must develop at least a minimal set of neuromuscular skills. (Williams)

79. If children are deficient in certain cognitive skills, the best solution to the deficiency to remediate the specific cognitive skills. Similarth motor skills are task specific and require task specific practice for their improment. (Thomas and Thomas)

80. Perceptual-motor development theory and research suggest that early sensory and motor experiences, physical activity, and cognitive growth are interdependent. (Williams)

81. Physical activity, through its positive relation to one's self-worth, may indirectly influence cognitive performance in children. The increased capacity to undertake physical and mental work may increase a child's confidence, thus enhancing body image, attitude, and goal achievement. (Williams)

82. If cognitive performance is a reflection of optimal brain growth and development, then sensory-motor stimulation must be considered an important factor in the early development of the child's cognitive behavior. Physical activity, in which vision and proprioception are stimulated, could contribute significantly to neural development. (Williams)

83. Blood flow to specific areas of the brain involved in the performance of a motor task may be increased by as much as 30%. Such evidence suggests a potentially important link between physical activity, sensory-motor stimulation, and cognitive performance. (Williams)

84. The first two postnatal years seem to be significant in promoting optimal development of brain function. At this time the child establishes a repertoire of manipulative and locomotor skills, learns to organize and use sensory information, and learns concepts of self, time, and space. These movement experiences provide the foundation for imitation, symbolic play and language, all of which are important in early cognitive functioning. (Williams)

85. Changes in brain structure and function are more likely to occur if there is physical activity or manipulation of the environment by the organism. Thus, motor involvement on the part of the organism is an integral part of the process that produces changes which accompany more refined neural function. (Williams)

86. Environmental stimulation may be an important factor in determining both the kind and range of stimuli to which the brain responds. In this way, sensory-motor stimulation, an inherent part of motor skill development, and physical activity may be extremely important in promoting optimal growth and development of the nervous system in infants and young children. (Williams)

87. Function of the central nervous system may be aided in several ways by exercise: (a) muscle contractions increase the health of its innervating neurons and neuronal network; (b) movement appears to produce changes in related neural structures of the brain; (c) neurotransmitter function increases with activity; and

(d) blood flow, which provides nutrients to support the increased metabolism in these associated regions as movements begin and continue, also improves. (Spirduso)

88. Because psychomotor behavior is dependent on the integrity of the central nervous system and physical fitness is related to psychomotor performance, this suggests that a lifestyle of exercise may maintain optimum brain function in some types of behavior. (Spirduso)

89. Physical education and sport each make valuable and unique contributions to the development of health, knowledge and skill of children, youth and adults. The need to justify either beyond their unique contributions is unnecessary and usually without cause. Neither sport nor physical education interfere with academic performance. Rather than trying to glorify physical education and sport with an academic rationale, we should do an excellent job of promoting fitness and developing motor skills. (Thomas and Thomas)

90. Athletics does not cause individuals to be better students; rather, some characteristics which influence athletic participation also influence academic performance. Conversely, athletics do not necessarily interfere with academic performance, nor with the curricular requirements and activities of most high schools. (Thomas and Thomas)

91. Generally, athletes are not less competent academically than non-athletes, nor does being a good athlete exclude a student from academic success. However, situations exist where the education of athletes is deemed less important than their athletic careers, and consequently, academic achievement is neglected. (Thomas and Thomas)

92. Sport has an overwhelming influence on black youth. The tragedy of the black athlete (who make up 50% of college athletes) is that only 25% of them graduate. Of these, 75% are enrolled in degree programs that are designed to keep them eligible, but not necessarily employable. (Thomas and Thomas)

93. Participation in physical education programs can contribute (probably indirectly) to student performance on academic measures. More importantly, it appears that more time could be allocated to instruction in physical education with no disadvantage to academic performance. (Vogel)

94. Participation in physical education programs can improve performance on selected measures of perceptual ability. There is no evidence, however, that these effects directly improve academic achievement. (Vogel)

CHAPTER SIX

Mental, Social, and Moral Development

The direct or adjunctive roles of physical activity in social and moral development and mental health has been debated for centuries. Historians have reported that Hippocrates prescribed exercise for his patients who suffered from mental illness; sports enthusiasts have argued that involving young people in athletics is an effective deterrent to socially undesirable behavior, and the adage that "sports builds character" is commonly used to promote athletic competition. The popularity of physical activity in the young, the middle aged, and the elderly is due, largely, to reasons that are not related to the further enhancement of skilled performance.

Despite the current health consciousness of the nation, there is evidence that mental health problems are exacting a tremendous toll from the American public. Statistics indicate that 10 to 15% of the population will fall victim, annually, to mental disease. Within a lifetime, one-third of American adults will experience a mental problem of significant magnitude for psychiatric intervention. Equally significant, however, is that only one in five will seek professional assistance and this will usually involve a primary care physician rather than a psychiatrist or psychologist.

The annual incidence of mental disturbance is alarming, but the figures become incomprehensible when they are translated into the actual costs for direct services and loss of productivity. The annual direct costs for mental health services are estimated at 14 to 19 billion dollars and the total costs, including lost productivity, are estimated at 40 billion dollars. These figures represent 8 to 15% of all national health care costs and 1% of the Gross National Product. Small wonder, then, that attention to cost effectiveness in health care has focused on physical activity as a preventative measure and as an attractive alternative to drugs as a treatment procedure.

Until recently, there was little scientific evidence to support or refute the numerous claims made for the benefits of physical activity in the areas of mental, social, and moral development. However, the current interest in health promotion, combined with the academic curiosity in such areas as sport and social psychology, psychiatry and general

psychology, behavioral and sports medicine, health psychology and preventive medicine have contributed evidence to clarify these issues. The general and specific situations in which physical activity contributes to social and moral development and mental health have been enumerated.

An accumulation of empirical and scientific evidence suggests that lifestyle behaviors, rather than human biology, environmental variables or our health care systems are primarily responsible for the quality and quantity of human life. We also know that moral growth is a developmental process and that it must be fostered by opportunities for development if it is to reach maturity. The reviews from which the following statements were obtained also suggest that physical fitness and prowess in sports are positively related to an elevated self-concept. Futhermore, the elevation or depression of self-concept appears to extend beyond specific sports situations.

The following statements should be a source of encouragement for all who have sought evidence of a positive relationship between physcial activity and social and moral development and mental health. Not only is the association confirmed, but situations in which these benefits are likely to occur also have been identified.

95. Exercise patterns must be habituated into the lifestyle of individuals if improvements in mental health are to be made. This implies that the development of childhood fitness and motor skills can serve as the motivation for continued participation in physical activity programs during adulthood. (Dishman)

96. The association between physical activity and mental health is sufficiently strong to warrant an increased emphasis by school officials and physicians for the promotion of physical fitness and the development of locomotor skills. (Dishman)

97. Regular physical activity is an effective, low cost, low risk behavior that not only has been shown to be effective in the promotion of mental health, but it may also be effective in the prevention of mental illness. Most individuals with mild to moderate mental health problems prefer to deal with them without the aid of professional help. Thus, personal coping skills, such as physical activity, seem to be ideally suited to the alleviation of mental stress. (Dishman)

98. Although the mechanisms whereby mental health accompanies exercise remains poorly defined, there is evidence that physical activity can be a low cost alternative to psychotherapy and counseling. (Dishman)

99. Moderately intense and graduated aerobic exercise can be an effective therapy for moderate depression and a temporary reduction in state anxiety. (Dishman)

100. Fitness programs and group exercise can increase self-esteem through social reinforcement or by fostering real or perceived gains in fitness. These gains are more likely to occur in children than adults because attributes other than physical performance become more highly valued as age increases. (Dishman)

101. Physical activity and positive mental health are directly related; numerous adjunctive associations also exist. These include increased assertiveness, confidence, emotional stability, independence, self-control, and body image. A decrease in anger, confusion, and phobias also are apparent. (Dishman)

102. Anxiety, depression, and anger have been effectively managed by changing thoughts, feelings, and perceived symptoms through exercise and/or settings where exercise takes place. For individuals suffering from depression, tension, or chemical dependence, appropriate kinds and amounts of activity can serve as a low risk alternative to prescribed drugs and their potentially harmful side effects. (Dishman)

103. The family has a significant influence in socializing children into physical activities. Families socialize children into physical activities that are deemed most appropriate for their socioeconomic status. There is a positive relationship between parental encouragement and actual participation in sports and other physical activities for both boys and girls. (Sage)

104. Schools, through physical education classes and interschool sports programs, serve as significant socializing agents for American youth. During late childhood, adolescence, and early adulthood, it is peers, rather than the family, who serve as the most powerful socializing agents for sport involvement. (Sage)

105. Play, according to developmental and cognitive psychologists, is an integral part of cognitive and social development. Play is regarded as important in the development of moral reasoning, motor skill, problem solving, creativity, and social efficiency. (Sage)

106. Games that emphasize cooperation are effective in producing cooperative social interaction among pre-school and elementary-aged children. (Sage)

107. The context in which sport activity takes place determines its social outcomes. Informal peer play emphasizes interpersonal skills and the search for self mastery; organized sports emphasize the learning of sports skills. Thus, organized sports for childern generally reflect the needs of adults rather than those of the children for whom they are organized. (Sage)

108. The organized, formal settings of many youth sports programs

may deprive children of an opportunity to play; rather, they may be occupied with obeying imposed rules, learning motor skills in a specific way, and acquiring values prescribed by adults. (Sage)

109. Significant differences exist in the organization of play between boys and girls, with the play of boys being more complex. (Sage). Advocates of coeducational sports activities have suggested that participation in sports provides an introduction to the competitive climate of the adult world of work but no evidence of this relationship is currently available.

110. Sports participants tend to be less delinquent than non-sport participants, especially among youth of the lower socio-economic classes. Involvement in sport, however, cannot be claimed at this time as the actual deterrent to delinquent behavior. (Sage)

111. A key ingredient in the development of desirable character traits through physical activity is the quality of the adult leadership. This suggests that physical education teachers and interscholastic coaches must model the behavior and attitudes that they wish to have their students emulate. (Sage)

112. Participation in sports is only relevant to academic achievement when it is associated with the encouragement of parents and friends. At the high school level, sports participation is more closely linked to educational aspirations than to the attainment of grades. (Sage)

113. Self-concept can be modified by sports involvement. Frequent winning or losing and success or failure will affect one's concept of ability. (Sage)

114. If competition is allowed to dominate the interpersonal relationships in children's sports, their potential for facilitating pro-social behavior is lost. Persons who have extended experiences in organized sports display poorer attitudes of sportsmanship than non-participants. Sports participants usually emphasize winning and skill development, while non-participating peers place a higher value on fair play. (Sage)

115. There is little empirical support for the notion that organized sport involvement leads to upward social mobility for large numbers of athletes. There is also little evidence that involvement in high school athletics leads to economic advancement. (Sage)

116. There is an intuitive belief that the intense achievement and expressive experience found in physical activities have the potential to influence personality development. However, if changes are to accrue, leaders of these programs must identify the personality characteristics they wish to nurture or change and then set about systematically creating physical environments that are

likely to produce the desired attributes. (Sage)

117. Because attitudes, values, and social behaviors are, to a large extent, based on one's self-concept, the outcomes of one's social experiences, including sports participation, can have a significant influence on self-concept. Successful participation in activities that demand cognitive, motor, and social involvement may foster the development of a positive self-image. (Sage)

118. Programs of physical activity, with their accompanying physical fitness, exhilaration, group identity, social affiliation, ego gratification, affective responses, and achievement generally lead to enhanced self-concept and self-esteem in both males and females. Although physical training programs generally lead to enhanced self-esteem, it is not certain that increased fitness contributes to this elevation nor that the elevated self-conception will endure. (Dishman; Sage)

119. Moral development, defined as the development of behaviors concerning the protection of rights, responsibilities, and the welfare of others, can be effectively implemented in physical education classes and interscholastic programs. However, it does not occur automatically; it must be an explicit goal that is addressed through instructional objectives. (Weiss and Bredemeier)

120. Moral growth occurs in developmental stages, as do intellectual and physical growth. Moral education, that is, the provision of experiences to promote moral reasoning and to encourage moral behavior, can be effectively promoted in physical education classes and interscholastic programs. However, teachers and coaches must be knowledgeable about how moral growth progresses if they are to facilitate its development. (Weiss and Bredemeier)

121. The reasoning process used by individuals determines whether they act in a morally mature way. Understanding the reasons underlying an action permits teachers and coaches to enhance moral development by structuring appropriate experiences and discussions.

122. Moral development can be fostered by explaining why certain rules exist or why certain actions are necessary to maintain order and discipline. Teachers and coaches must give students opportunities to question actions and regulations and be willing to offer explanations as a part of enhancing the moral development of their students. (Weiss and Bredemeier)

123. Teachers and coaches can foster moral behavior by adopting a moral code, identifying appropriate and inappropriate behaviors, and suggesting strategies for controlling their behaviors.

Modeling appropriate behaviors and reinforcing them in students are effective ways of promoting moral development. (Weiss and Bredemeier)

124. Moral development is fostered when there is an opportunity to assume roles, experience moral conflict, and negotiate solutions to problems. Deprivation of these opportunities by imposing structured environments may stifle moral development. The highly structured situations in some youth sports programs, physical education classes and interscholastic athletics may not provide sufficient opportunities for moral development to occur. (Weiss and Bredemeier)

125. The psychological and social stigma of childhood obesity may be as destructive to healthy development as the medical hazards of sports which have been so clearly defined in the last decade. (Eisenman)

126. Many obese people suffer from a depressed self-concept and are preoccupied with their weight and appearance. Participation in exercise programs can enhance the ability to deal with stress, improve self-esteem, and stimulate loss of body fat. (Dishman; Eisenman)

127. Reduction of body fat in obese children has been accomplished by the combined intervention of physical activity, psychological counseling, and education about nutrition. (Eisenman)

128. Although self-concepts have been changed through participation in structured activity programs, there is no evidence that participation in physical education programs improves self-concept or personality. The fact that self-concept has been changed in other non-school activity settings suggests that such changes could also occur in school-related programs if ample emphasis was placed on these objectives. (Vogel)

CHAPTER SEVEN

Special Conditions, Aging and Activity

The influence of physical activity on bodily function is dramatically evident in several populations where its availability is often restricted; that is, with the physically and mentally impaired and our aged citizens. Recent attention to the needs of handicapped persons has demonstrated significant improvements in their neuromotor and cardiorespiratory functions and in their social and perceptual development when objectives for these improvements have been integrated with physical activity programs.

Extending the benefits of activity that were formerly reserved for young, able-bodied persons to handicapped citizens of all ages is a relatively recent occurrence. Preliminary evidence indicates that the benefits of physical activity may serve both a direct and an adjunctive role in special populations, thereby extending the value of well-planned programs beyond their immediate benefits in motor performance and health-related fitness.

Aging is a process that begins at conception, but it is seldom of concern to us until we reach middle age or suffer from a disability which restricts our capacity to meet functional expectations. The increasing age of our population has stimulated numerous investigators to determine how lifestyle can be changed to forestall the debilitating effects of old age. Although the eventual outcome to life's processes is predetermined, there is abundant evidence that the quality of life can be enhanced through the cumulative effects of environmental variables under our control; paramount among them being a lifelong devotion to proper physical activity. The following statements underscore the benefits of physical activity to special populations.

129. About 10% of the total U.S. school age population is classified as disabled or handicapped. Learning disabled students compose the largest category of handicapped school children, followed in descending numbers by the speech impaired, mentally retarded, emotionally disturbed, physically disabled, hard of hearing, visually impaired, and others. Mounting evidence indicates that all handicapped individuals can gain both psycho-social and physiological benefits through properly planned and conducted

activity programs. Individuals with disabling or handicapping conditions, whether physical, mental, or emotional, may benefit from properly graded physical activity in the same manner as those without handicaps. (Morris)

130. Positive changes in measured intelligence may occur when appropriate physical activity lessons are added to the daily schedule of mentally retarded elementary school aged children. These changes are most likely attributable to increases in attending behavior, problem solving strategies, or other functions that have similar requirements during the activity sessions and the academic setting. (Morris)

131. Improvements in mental health and self-concept among handicapped individuals have been attributed, in part, to increases in physical fitness. (Morris)

132. Wheelchair athletes of the elite type are far superior physiologically, when compared to sedentary wheelchair users. However, they fall within the range of normal, able-bodies athletes. (Morris)

133. Specific physical tasks may aid learning disabled students' progress in the academic sphere; their participation in sports correlates positively with academic and social success. (Morris)

134. Disabled students who particpate in sports, physical activity, and/or recreational programs have shown improvements in self-concept and self-acceptance. Optimal benefits may result from activities in which people with disabilities compete against healthy individuals on an equal basis. (Morris)

135. Mildly mentally retarded and minimally brain damaged school children have shown improved motor performance, as well as intellectual and emotional development, after participating in a planned, controlled program of physical activities. (Morris)

136. Elementary school students with speech impairments can improve speech patterns and articulation if properly guided in carefully designed physical activity. (Morris)

137. Chronic degenerative cardiovascular disease (CVD) is a primary health care problem and is one of the leading causes of death in the United States. This figure suggests that efforts to prevent CVD through diet and exercise for young individuals would be a prudent expenditure. (Freedson)

138. The mortality rate for cardiovascular disease (CVD) in the United States has declined in the past 15 years. For example, the death rate from coronary heart disease (CHD) has decreased at least 20% among white and nonwhite males and females between the ages of 35 and 75 years. The factors suggested to be associated

with this decline in CHD mortality are improved medical treatment and lifestyle modification, including such favors as decreased smoking, dietary alterations, and an increase in physical activity. For example, in 1984 it was reported in a Gallup Poll that the number of adult Americans involved in "daily exercise" was nearly double the participation rate observed in 1961. (Freedson)

139. Numerous physiological adaptations occur subsequent to exercise training in the CHD patient. These adaptations include a decrease in resting heart rate, a decrease in submaximal exercise heart rate and systolic blood pressure, a decrease in submaximal exercise myocardial oxygen consumption, an increased peripheral utilization of oxygen, and an increase in aerobic work capacity ($\dot{V}O_2$ max). (Freedson)

140. Rehabilitation in cardiac patients who undergo long-term, high intensity exercise training may show changes in cardiac function similar to those observed in healthy individuals. (Freedson)

141. High levels of fitness are associated with a favorable blood lipid profile, particularly with high density lipoprotein levels. Regular physical activity also improves the aerobic capacity in individuals with coronary heart disease, by increasing the peripheral use of oxygen. (Freedson)

142. Patients with pulmonary diseases experience an improved exercise capacity, without apparent improvements in physiological and hemodynamic function, as a result of involvement in exercise programs. Exercise has a positive effect on the quality of life and may even facilitate independent participation in activities of daily living in pulmonary patients. (Freedson)

143. Regular physical activity appears to have a beneficial influence in the reduction of blood pressure in individuals with hypertension. (Freedson)

144. Physical activity is a medically accepted component of management for insulin-dependent and non-insulin dependent diabetics. When beginning a regular program of physical activity, insulin dosage can usually be reduced by 20 to 40%. During periods of prolonged heavy physical activity, it is recommended that the diabetic ingest some carbohydrate every 20 to 30 minutes. (Berg)

145. Chronic lack of insulin accelerates protein degradation and encourages muscle atrophy. Administration of adequate amounts of insulin or oral medication appears to enhance muscle development. The diabetic uses protein as a source of fuel for energy production to a greater extent than the non-diabetic. (Berg)

146. Excess insulin in the blood during exercise will produce low blood

sugar. Diabetics should not exercise if ketones are present in the urine or blood sugar levels are unduly high. Exercise will greatly increase the blood sugar and ketone levels under these conditions. (Berg)

147. Until recently, persons with diabetes mellitus were not strongly encourged to participate in exercise or physical training programs. Today, newly diagnosed diabetics are often encouraged to exercise as part of their overall management program. Diabetics who are medically controlled appear to experience the same training effect as non-diabetics. Many diabetics have a greatly limited capacity for exercise because of existing medical problems such as cardiovascular disease, eye disease, kidney damage, and nerve damage. (Berg)

148. Backache is a common problem of pregnancy, resulting from postural changes which occur to compensate for the shift in the center of gravity as the abdomen enlarges. Exercises that strengthen the back and abdominal muscles should reduce the discomfort. (Wells)

149. Exercise appears to be tolerated very well by both the expectant mother and the fetus during pregnancy, even though there is a considerable loss of maternal cardiovascular-respiratory reserve. Women with higher levels of fitness have had significantly shorter periods of labor in pregnancies following their first child than less fit women. (Wells)

150. Instructors providing physical activity for pregnant women should lower exercise intensity and perhaps shorten exercise duration in cases where general discomfort occurs. A physician should be consulted immediately if any of these problem signs appear: vaginal bleeding, high blood pressure, pain, ruptured membranes, or absence of fetal movements. (Wells)

151. Concern about the long-term effects of strenuous athletic training on pregnancy and childbearing have no basis in fact. Several studies provide evidence that women athletes are more likely to have normal pregnancies than sedentary women. (Wells)

152. There is a mounting concern about a common metabolic bone disease known as postmenopausal osteoporosis. Research clearly indicates that bone loss in the elderly female can be retarded and necessary bone mineral maintained at a higher level when sufficient weight bearing physical activity is present. (Wells)

153. There is no gender difference in the ability to profit from strenuous exercise. The menopause or the climacteric years of one's life do not call for a decrease in physical activity. All research findings

indicate that exercise is highly beneficial to one's well-being at all phases of life. (Wells)

154. Exercise, as a normal part of life's activities or as a lifestyle intervention, can prevent some disease processes and postpone others. Exercise is much more cost effective than medical treatment in reducing the debilitating effects of old age. (Spirduso)

155. Spontaneous physical activity is inversely related to age; yet physical activity has been shown to be beneficial at all ages (Spirduso). The challenge to teachers and supervisors of activity programs is to involve children, adolescents, and adults in experiences that maximize the health-related benefits and the desire to remain active. (Eisenman)

156. The long-term compliance to regular exercise programs is disappointing. Therefore, program sponsors must integrate motivational strategies with the activities. (Eisenman)

157. The benefits of regular exercise for older individuals are numerous. Both males and females experience, through consistent submaximal exercise, an increase in maximal oxygen consumption, stroke volume, recovery heart rate, post-exercise blood lactate levels, oxygen pulse, and increased systolic blood pressure. Thus, well conditioned older individuals can function as well or better, aerobically, as less well-trained, younger individuals. (Spriduso)

158. The evidence that consistent lifelong exercise will lengthen the life span of human beings is weak or non-existent. More likely other beneficial health habits such as non-smoking, weight control, good nutrition, medical attention when needed, ample sleep, and moderate alcohol consumption are also practiced by chronic exercisers. It is the cumulative beneficial effect of all these variables that enables individuals to fulfill their life expectancy. (Spirduso)

159. Absolute endurance declines with age, but training retards this decline. When endurance is expressed as a percent of maximum strength held over a period of time as in grip strength endurance, performance can be maintained or improved up to the eighth decade. (Spirduso)

160. Strength training produces muscle hypertrophy in elderly individuals. Older individuals have demonstrated significant and similar percent increases in strength after eight weeks of training similar to those obtained by younger individuals. This suggests that the benefits of strength training so commonly associated with athletes are also available to older individuals. However, because of the demands made by strength training on other systems, it

should be conducted with proper precautions in older adults. (Spirduso)

161. Maximum isometric and dynamic muscular force decline with age; dynamic strength decreases more than isometric strength. The speed of muscular contraction is reduced, probably because of the selective loss of fast-twitch muscle fibers. Although there is greater absolute loss of strength in the old than in the young, the rate of relative tension development is the same. (Spirduso)

Summary: A Position Statement On the Benefits of Physical Activity

Modern American society presents a contrast in lifestyle relative to the health and fitness of its members. A recent survey concluded that approximately 50 million adults exercise vigorously for at least one half hour three times weekly. Conversely, periodic national assessments of the physical fitness of our youth have failed to detect any improvement in their condition since the rather disappointing results of 1965. Educational programs have recently heeded the call for a return to the "basics" in science, mathematics, and reading, but simultaneously, many schools reduced or eliminated the time devoted to physical education.

Recent statistics show that American affluence cannot buy good health, nor can we long afford to pay for health care at its current prices. Despite the rising costs of health care, we have been slow to adopt prudent alternatives to unhealthy lifestyles. Specialists in health promotion predict that one-third of all adults will suffer from a significant mental illness during their lifetime. The costs associated with mental illness are estimated to be 40 billion dollars annually. Chronic degenerative cardiac disease afflicts millions of Americans, with 1,250,000 suffering from heart attacks annually. The annual indirect costs of heart disease are estimated to be 20 billion dollars. In the year 1981, health care costs in the United States totaled 286 billion dollars. The logical conclusion to the foregoing statistics is that we cannot afford to continue this devastation of our human resources. Clearly, a strategy of intervention beyond those presently in operation is required.

The problems of caring for an unhealthy population is too complex to be solved by proposing simple solutions, so none will be attempted here. However the preventive and rehabilitative implications of physical activity seem obvious and compelling. In addition, physical activity has many attributes that complement its beneficial effects. Among them are:

Activity represents a fundamental need. All human beings require a minimum of activity to maintain the integrity of bone, muscle, blood, and nervous tissue.

Accessibility. The many forms of activity lend themselves to a variety of settings.

Unusual appeal. Some beneficial activity or form of exercise can usually be identified for the various preferences of individuals.

Economic feasibility. Many activities are free or inexpensive, thereby extending their availability across the socioeconomic spectrum.

Universally beneficial. Activity has been shown to contribute to the health of young and old, male and female, physically and mentally able and disabled, and trained and untrained individuals. The combined attributes of physical activity are an appealing alternative to the consequences of inactivity.

A fundamental principle in acquiring the maximum benefits of exercise is that participation must begin at an early age and extend throughout the life span. The following statements from research evidence support this conclusion.

- The beginnings of unfitness, as expressed by cardiac risk factors, are identifiable in early childhood.
- Thirty percent of American children are classified as obese and 80% of these will become obese adults.
- Obesity is closely related to America's number one killer, heart disease, and numerous associated conditions.
- Bone, muscle, and nervous tissue require regular, vigorous activity to maintain their integrity and to grow in a normal manner.
- Mental illness can be prevented and mental health restored by appropriate kinds and amounts of activity.
- The debilitating effects of old age can be effectively postponed or reduced by exercise.

The inescapable conclusion that emerges from the extensive review of literature found in *Physical Activity & Well-being* is that physical activity represents a cost-effective means of promoting good health and enhancing the quality of life, especially when it is available to the nation's youth. The ideal vehicle for its incorporation into daily lifestyles, that is, physical education in the nation's schools, is a relatively untapped resource. Although most school systems purport to have physical education programs, there is a general concensus that many have been ineffective in achieving the objectives that are clearly within the domain of health-related fitness and motor skill acquisition. Thus, the redirection of ineffective physical education programs appears to be a feasible, low-cost solution to the dilemma of unhealthy youth. The following recommendations call for a rededication of education programs to achieve defensible outcomes:

- Physical education programs should focus on the objectives of healthy-related fitness and motor skill acquisition as major priorities.
- Because of their cost-effectiveness in promoting health and preventing disease, physical education programs should be available throughout the K-12 curriculum to all students on a regular basis.
- Physical education programs should emphasize a sequential progression of skills and knowledge related to the attainment and maintenance of a healthy lifestyle.
- Physical education programs should be designed and regularly evaluated in terms of the degree to which students are achieving their stated objectives.

Glossary

Aerobic. With oxygen present. Aerobic energy system—the body's use of oxygen from the air to help provide fuel for movement and other body functions; distance running and the long duration activities are fueled primarily by the aerobic energy system.

Anaerobic. Lacking oxygen; in the absence of oxygen. Anaerobic energy systems—the two means of fueling activity by the breakdown of high-energy compounds within the body, without the use of oxygen; sprinting and other short duration movements are fueled primarily by the anaerobic energy systems.

Anaerobic Threshold. The level of activity at which the body ceases to rely on the aerobic energy system but, rather, depends on the anaerobic energy systems for fuel.

Anemia. Abnormally low amount of red blood cells in the blood.

Anthropometric. Related to measurements of the human body, i.e., lengths, widths, girths. Example: sitting height.

Anxiety. A state of severe apprehension and tension.

Arteriovenous Oxygen Difference. The difference between the oxygen content of oxygenated and deoxygenated blood.

Atherosclerotic Diseases. Diseases characterized by the narrowing and hardening of the large and medium sized arteries due to cholesterol (plaque) buildup on the artery wall.

Basal Metabolic Rate. The minimum rate of energy expenditure when the body is at complete rest.

Benign. Favorable for recovery, neither recurrent nor malignant.

Biological Age. Age expressed as the chronological age of the average individual showing the same body development.

Blood Lipid. The fat normally found in the blood.

Blood Pressure. The force of the blood on the walls of the arteries that moves the blood through the circulatory system, read as two numbers—the larger being systolic blood pressure and the smaller being diastolic blood pressure. Example: 120/80.

Blood Volume. The amount of blood in the body, usually expressed in quarts or liters.

Bone Density. The compactness of bone, referring to the amount of mineralization in the bone.

Capillary Density. The number of minute blood vessels (capillaries) per amount of body tissue.

Carbohydrates. Sugars and starches.

Carbon Dioxide Production. Gas formation resulting as a by-product of metabolism.

Cardiac Output. The amount of blood pumped by the heart per minute.

Cardio-respiratory. Involving the heart and lungs.

Causal. The existence of one or more things contributing to the existence of something else.

Central Nervous System. The brain and spinal cord.

Cerebral Cortex. The outermost layer of the brain; it is responsible for receiving and interpreting sensory information, organizing complex motor behavior and storing knowledge.

Chronic. Of long duration.

Chronological age. Age expressed as time since birth.

Circumpuberal. Around the age of puberty.

Climacteric. Menopause, and the corresponding normal reduction of sexual activity in the male.

Cognition. An act or processes by which people gain knowledge of the world.

Cognitive. Related to knowledge.

Compulsive. Feeling an overwhelming pressure or obligation, even to the point of obsession.

Contextual Conditions. A set of circumstances that surround and subsequently affect a behavior or performance.

Contractile Proteins. The muscle components that bring about muscle shortening.

Contraction. A shortening of muscle length, usually associated with development of muscular tension.

Correlational. When two or more things, attributes, parts, etc. are mutually related.

Cross Cultural Investigation. A study that attempts to look at a problem, idea, population, or question by examing it in more than one culture, and comparing the results.

Cross Sectional Design. An experimental design that looks at several subjects or variables, in one time period.

Cultural Transmission. Transferring knowledge, action, speech, behavior, art, and humanities to succeeding generations.

Dehydration. Excessive loss of body water.

Depression. A condition of prolonged dejection, sadness, and withdrawal.

Development. The process of growth towards higher levels of functioning.

Developmental Psychologist. One who studies changes in behavior that occur as people get older.

Diabetes. A general term referring to abnormal, excessive urine excretion. Non-insulin dependent diabetes—diabetes in which the patient is not dependent upon insulin theapy.

Differential Reinforcement. In the presence of two or more behaviors, rewarding the desired behavior so it will occur more frequently than the undesired behavior.

Dysmenorrhea. Painful menstruation.

Eating Disorders. Disturbances in eating behavior, such as anorexia nervosa and bulimia.

Electroconvulsive Therapy (also called electroshock therapy or ECT). A treatment for more severe mental problems by inducing a temporary coma through the use of electric current.

Electrolyte. A chemical that dissolves in a solution. Example: salt.

Empirical Research. Research that is based primarily on observation and experience.

Encoding. The process of converting information to an understandable level for oneself.

Endomorphic. A soft, rounded body build, with greater fat content than lean or muscular body types.

Enzymes. Proteins that speed up chemical reactions in the body.

Equivocal. Uncertain or undetermined significance.

Ergometer. An instrument for measuring the work performed by a group of muscles.

Fast-Twitch Muscle Fibers. Muscle cells fueled primarily via the anaerobic energy system.

Feedback. Knowledge of the results of a behavior or performance.

Glycogen. The chief carbohydrate (starch + sugar) storage material in the human body.

Growth. An increase in size.

Hemodynamic. Relating to blood circulation.

Hemoglobin. The part of the red blood cell that carries oxygen from the lungs to all parts of the body.

Heterogeneity. The state of being different and dissimilar.

High Density Lipoprotein. A beneficial fat and protein molecule in the blood.

Hyperlipidemia. An excess of lipids (fats) in the blood, usually as a response to a metabolic disorder.

Hypertension. Abnormally high blood pressure.

Hypertrophy. Increase in bulk without increasing number of parts.

Hypoglycemia. Abnormally low blood sugar (glucose).

Indices. Plural of index.

Insulin. A substance normally produced in the pancreas and used in the treatment of diabetes.

Intrauterine. Within the uterus.

Isokinetic Exercise. An activity in which a muscle contracts and shortens while developing a maximal tension throughout the entire contraction motion.

Isometric Exercise. An activity in which a muscle contracts and develops tension, but the muscle does not change length. Example: standing motionless and pushing against a wall.

Isotonic Exercise. An activity in which a muscle contracts and shortens while developing tension. Example: the biceps in a chin-up.

Ketone. A by-product of metabolism, evident in the urine in large amounts when fats are the primary energy source, as in diabetes.

Kinesthetic. Related to the sense by which movements and positions of body parts are perceived, from information arising within the muscles, tendons, and joints, sensory information other than visual and auditory.

Lactic Acid. A waste product of the anaerobic energy system that causes muscle soreness.

Life Span. The average length of life of a species.

Maturation. Progress toward the mature state.

Maximal Aerobic Power. The fastest rate at which oxygen can be taken in and used by the body to produce energy. Example: a marathon runner has a higher maximal aerobic power than a sedentary individual.

Menarche. The first menstrual flow of a women's life.

Menopause. Natural cessation of menstruation, usually between ages 45 and 50.

Mesomorphic. A muscular body build, as contrasted to lean or obese body types.

Metabolism. The building up and usage of substances in the body.

Mitochondria. Energy producing sites in the body's cells.

Model. A standard or example to imitate or follow.

Modeling. Performing a task or behavior so that others can learn it by observation and imitation of it.

Myocardial Oxygen Demand. The amount of oxygen required to fuel the heart muscle.

Neonatal. Pertaining to the first four weeks after birth.

Neurological. Related to the nervous system and nerves.

Neuromuscular Tension. Stress that affects the nerves and muscles.

Neuroticism. A condition of being somewhat unstable in character or condition.

Osteoporosis. Abnormal dissolving of bone, resulting in porous, less dense bone.

Oxidative Enzyme. A protein that speeds up aerobic metabolism.

Oxygen Uptake. The rate at which oxygen is taken in and used by the body to produce energy.

Panic Disorders. Recurrent anxiety attacks that are usually associated with a situation, but can also occur unpredictably.

Parameters. A boundary or limitation on something.

Physique. Body structure or type.

Plasma Volume. The amount of the liquid component of blood (excluding blood cells and platelets) in the body.

Precursor. One that comes before another.

Proprioceptive. Referring to information from internal sensors regarding movement and position of the body.

Postmenopausal. Occurring after the cessation of menstruation (menopause).

Postnatal. Relating to the infant after birth.

Psychiatric Episode. A relatively brief period of emotional, mental, or behavioral disturbance.

Psycho-social. A psychological dimension of a social factor, like team cohesiveness.

Psychotherapy. The treatment of mental, personality, and emotional problems, as well as related physical ills, using psychological means.

Psychotropic Medication. Medicine or drugs that exert an effect on the mind.

Pulmonary. Referring to the lungs.

Red Cell Mass. The amount of red blood cells in the blood; red blood cells carry oxygen from the lungs to all parts of the body.

Reflexes. Quick, involuntary reactions. Example: knee-jerk reflex, a straightening of the knee when the quadriceps tendon is tapped.

Renal. Pertaining to the kidneys.

Respiratory Rate. Breathing rate, usually expressed as breaths per minute.

Retinopathy. Disease of the retina of the eye.

Saturated Fat. A fat that is solid at room temperature, as distinguished from an unsaturated fat which is liquid (oil) at room temperature.

Self-concept. The mental or cognitive image of oneself, including the ideas and attitudes we have about our awareness.

Self Esteem. The positive or negative evaluation one has of oneself, the extent to which one values oneself.

Self Identity. Having self-understanding and full awareness of oneself.

Serum cholesterol. A fat-like substance in the blood; cholesterol (plaque) builds up on artery walls in artheriosclerotic disease.

Skeletal Age. Age expressed as the chronological age at which the noted bone development is attained.

Skeletal Mineralization. The natural deposition of minerals (esp. calcium) into the bones, thereby strengthening them.

Social Interactive Behavior. Behavior that consists of communicating cooperatively with others.

Social Learning. Learning that occurs as a result of observing others and receiving reinforcement from others.

Socializing Agent. One who imparts the norms, values, beliefs, and ideas of a culture or environment (e.g. teacher or coach).

Stature. Natural standing height.

Stimulus. Something that encourages action, feelings, or thoughts.

Stroke Volume. The amount of blood pumped by the heart in one beat.

Structural Development Theory. The theory which states that cognitive knowledge is developed through the reorganization of groups or structures of information, within the mind.

Submaximal Exercise. Activity that does not require maximal aerobic power.

Titrate. To determine the strength of a solution, substance, or treatment.

Triglycerides. The fat storage material in human beings.

Vestibular. Referring to the vestibular apparatus, located in the ear, which senses the position of the head in space and sudden changes in the direction of movement of the body.

Work Efficiency. The amount of useful work produced per amount of energy expended.